

A Comparison of Routing Protocols, Applications in VANET

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Abstract –VANET (Vehicular Ad-hoc Network) is another innovation which has taken huge consideration in the current years. The consolidated impromptu system, remote LAN (WLAN) and cell innovation to accomplish clever between vehicle correspondences and enhance street movement security and productivity is advanced. VANET is a subclass of Versatile specially appointed systems which gives a recognized way to deal with Insightful Transport Framework (ITS). VANETs are recognized from different sorts of specially appointed systems by their mixture arrange designs, attributes, and application situations. In this paper, we discussed characteristics, advantages, applications of VANETs and survey recent protocols based on routing. Lastly, the paper accomplishes by a horizontal comparison of the numerous routing protocols for VANET.

Keywords – VANET (Vehicular ad-hoc network), Local Area Networks, Intelligent Transport System and characteristics in VANET.

I. INTRODUCTION

Today's scenario is always changing. Network and data communication have changed their business and daily affairs. Number of devices connected by media link is known as network. A network is a telecommunication channel through which one can share data within set of computers connected in same network is a *data network*, for example: Internet. Computer network is different from distributed system.

1.1 VANET

A network, which interconnects the vehicles on road is VANET (Vehicular Ad Hoc Network). VANET is an innovation utilized by moving autos to make Mobile systems. Vehicles in VANET are Dedicated short range correspondence (DSRC) prepared [1]. Each vehicle will turn into a hub in VANET and get and radio messages through network. VANET changes over every auto into remote hubs and make extensive variety of system. The cars, out of range, drops out and new cars join in and coordinate with an innovation for police and fire vehicles to convey each other. VANETs has a place with remote specially appointed system. VANET otherwise called Inter Vehicular Communications (IVC). The motivation behind VANETs is to expand street wellbeing with remote correspondence, because of which VANETs require secure directing conventions. VANET impacts the change of ITS to give solace and wellbeing to clients [2].

VANET implies that nodes in VANETs are base stations or Vehicles. Both public (like buses, police cars, ambulance etc.) and private (individuals, private company cars etc.) vehicles can be included. Vehicles can communicate with roadside units as well vehicles itself interchangeably. Scale of VANET sets the vehicles apart from hundreds of nodes distributed everywhere.

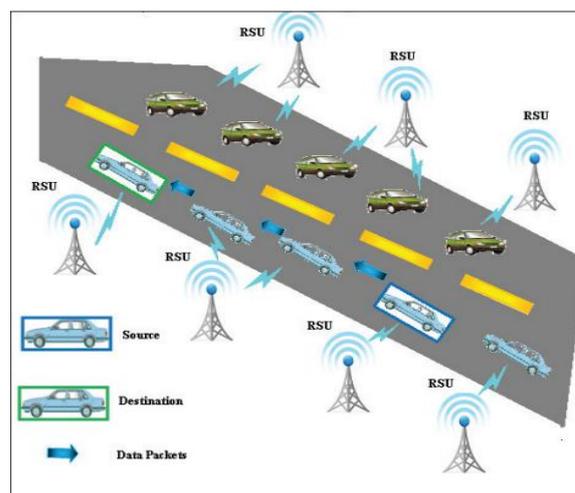


Figure 1: Architecture of VANET [3]

1.2 CHARACTERISTIC OF VANET

VANETs are application of MANET, with its own set of unique characteristics divided as:

- **Mobility is high:** VANET vehicular nodes are moving relatively at faster speed due to which the VANET's structural becomes harder to predict and highly dynamic.
- **Restricted Mobility Patterns:** Unlike MANETs, VANET's movement of nodes governed by certain access authorized rules that are least predictable in short run.
- **Network Topology:** VANET's high speed characterization of nodes leads to continuous change in topology. Due to which high communication overhead was introduced to exchange new topology data.
- **No Power Constraints:** battery equipped vehicles have immeasurable power-supply for communiqué and computation resources.
- **Positional:** VANET vehicle uses GPS system to identify locations with accuracy and gather information from roadside units and other vehicles.
- **Abundant Networks Nodes:** unlike MANETs, VANETs has huge network as designed for wireless environment. Data exchange via wireless.
- **Hard Delay Constraints:** the main objective of (Vehicular Ad-Hoc Network) VANET is to offer safety messages which is prioritized and delivered on time. [4]

1.3 ADVANTAGES OF VANET

Various benefits of VANET offers to its users like:

- VANETs promises better integration of digitized environment, from vehicles, roadside devices traffic lights, etc.
- High speed vehicles can communicate through wireless connections become technically and electronically feasible for new traffic services.

1.4 TYPES OF VANET

- **Communication in Inter-Vehicle:** In such formation Multi-hop broadcast or multicast is used for the passage of traffic related data to the groups of users or receivers
- **Vehicle-to-Roadside Communication:** A single hop broadcast is represented in this configuration in which broadcast message was send by roadside unit to all equipped vehicles in nearby region.
- **Routing Based Communication:** This configuration uses multi-hop unicast in which a communication is spread in multichipelegance until the vehicle with wanted data is touched.

1.5 VANET APPLICATIONS

Several implementation of VANET are based on car to infrastructure and car to car traffic or car to home applications as well as routing based applications are widely classified as Safety oriented, Convenience, commercial

oriented and productive applications. Different implementations are: [5]

- **Real Time Traffic:** A genuine real time traffic information saved at RSUs and available to all automobiles whenever required. It play significant role in solving problems like: congestions, emergency, etc.
- **Co-operative Message Transfer:** Slow or non-moving vehicles will transfer messages to assist other vehicles. Latency and reliability are key concern and automate things to avoid situations like accidents, etc.
- **Internet Access:** Automobiles can access network via RSU, in case those RSUs are performing as routers.
- **Digital Map Downloading:** Drivers can download area maps as per requirement to travel new place for guidance. Portable maps can also be used.
- **Route Diversion:** Planning trip or route can be altered as per situations or in congestion.
- **Parking Availability:** Notification related to availability of parking area assists to find the available space in specific region.
- **Time Utilization:** Reading mails or doing work while in jam packed areas, one can utilize the free time to do something productive.
- **Fuel Saving:** Stopping the ignition while waiting on the toll booths or on traffic lights can save around 3% of fuel.

II. LITERATURE REVIEW

Salvador Gonzalez, et al., (2016) [6] proposed a VANET (Vehicular ad hoc networks) to help the driver on road. Several applications require VANETs are needed, e.g. suggesting routes for given destination, managing traffic, or avoiding risks for driver on road. They have focussed on transmission message for teamster safety. The broadcasting should be quick and secure so that all vehicles in specific area quickly obtain messages. To get better view of broadcasting techniques they evaluated group of protocols representing broadcast method.

They significantly minimize the delay, and simultaneously keeping a security. Moreover, they modelled different broadcasting techniques for emergency packet in VANET and hence, implemented a subset of protocols to implement those techniques.

Kit Guan Lim et al., 2016 [7] proposed VANET to avoid increased on-road vehicle and accidents, generally caused by human errors. Currently VANET is an active area of research. The networking and mobility component are necessary to create a VANET. Mobility component was discussed and some mobility simulators were introduced with the help of related work for each simulations. MATLAB and urban mobility simulation are used for

VANET simulation and simultaneously, traCI4 MATLAB, an API (application programming interface) developed in MATLAB to allow connection among applications written in MATLAB. They also discussed SUMO simulator.

NehaGoel et al., 2016 [8] presented different effective routing protocols based on positions. In VANETs, automobiles communicate each other or RSU to avoid traffic and accidents. For such communication, VANETs need a routing protocol to assist vehicles for data exchange on network. Routing packets in VANET is a stimulating job due to active nature of VANET. Out of several routing protocols of VANETs, position based routing protocol are promising ones, as it assists geo-graphical position data or packet of vehicles to give efficient routing in vehicular systems.

Arohi Gupta et al., 2016 [9] reviewed VANET and compared DSR, DYMO, AODV and OLSR routing protocols with their pros and cons. VANET is rapidly growing technology supply connection among moving vehicles on road and road side without using infrastructure. VANET is a sub-category of MANET with a unique property of vehicles as nodes. VANETs are primary component of ITS and self-organizing. It's not easy to create an efficient algorithm due to its random topology and continuous disconnection. Any routing protocol can't be efficient in any of VANET's scenarios, hence it's necessary to review the protocols already in use along with their merits and demerits.

B.Ayyappan et al., 2016 [10] discussed VANET and related challenges. Recently, VANET is emerged as an active area of research. It utilizes several requirements of WLAN 802.11 domestic. The rudimentary ad hoc system and VANET generates a system, which is a group of independent entities capable to communicate with each other. The Adaption to several properties 802.11 family causes a noticeable increase wireless network. The VANET

has many benefits as well as challenges comprised of privacy, security, effective bandwidth utilization, Quality, etc.

J.Jenefa et al., 2016 [11] summarized authentication strategies to establish secure communication using Vehicular Ad hoc Network. VANET is a categorical type of MANET which is developed by mobile vehicles, RTA (Regional Trusted Authority) and fixed RSUs (Road Side Units). Connection must be established in reliable way to identify intruders in network and separate them out of network. Several authentication strategies were proposed for same purpose.

III. ROUTING PROTOCOLS IN VANET

Routing protocols are designed to discover the communication track in between the transmitter and receiver. These are necessary and plays crucial role in presentation of VANET. Direction-finding protocols are the standards to authorize the nodes to decide a manner in which packet is transmitted among the devices in VANET. Several properties are expected from routing protocols are:

- It should be dispersed in a way to maximize the authenticity.
- It must be sketched after examining the one way links because it improve the performance.
- It should be power efficient because laptops and PDAs have limited battery source.
- Radio network is vulnerable to attacks; therefore security measures are also necessary.

The highly dynamic topology designs energy efficient routing rules for Vehicular Ad-Hoc Network is a challenging task. The over-all classification of VANET routing rules has been shown in the figure 2.

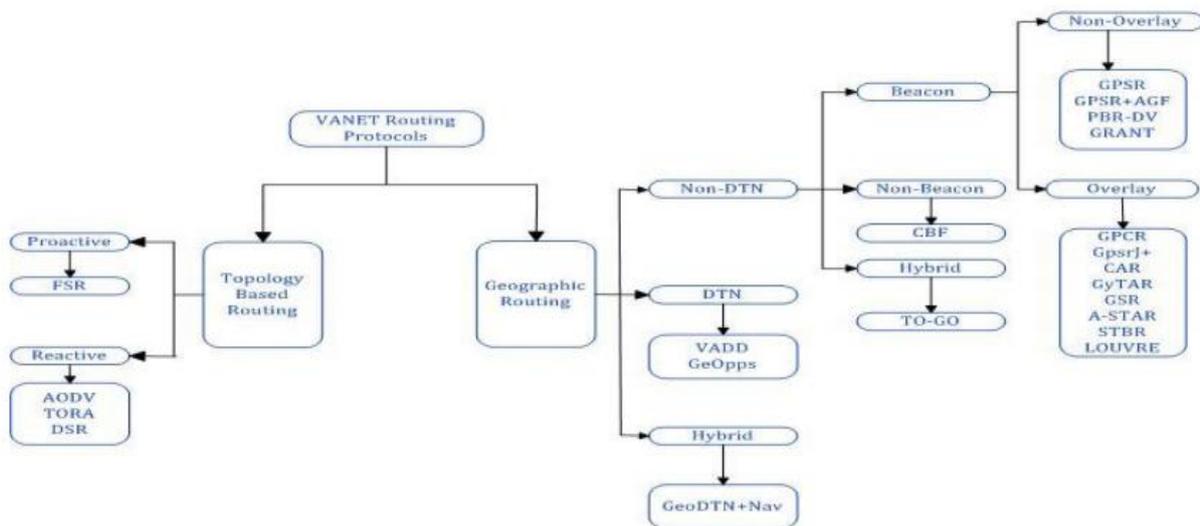


Figure 2: Routing Protocols in VANET [12]

3.1 TOPOLOGY BASED ROUTING PROTOCOLS

The connection's data inside the system is utilized as a part of Topology-based directing conventions to send the information bundles from source to goal. Such conventions are additionally ordered into proactive (table-driven) and responsive (on-request) directing.

3.1.1 Pro-active (table-driven)

Proactive directing conventions are for the most part in light of briefest way calculations. The insights of associated hubs are kept in forbidden shape on the grounds that these conventions are table based and these tables are additionally imparted to their neighbours.

Advantages

- No Course Revelation is required.
- Low Dormancy for continuous applications.

Disadvantages

- Unused ways involve a huge piece of the accessible transfer speed.

3.1.1.1 Fisheye State Routing

FSR [13] is a proactive or table driven directing convention where the data of each hub gathers from the neighbouring hubs. At that point compute the steering table. FSR is connecting state steering and a change of Worldwide State Directing based.

Advantages

- FSR fundamentally diminishes the expended data transfer capacity as it trades halfway steering refresh data with neighbours as it were.
- Reduce directing overhead.
- Changing in directing table won't happen regardless of whether there is any connection disappointment since it doesn't trigger any control message for interface disappointment.

Disadvantages

- Very poor execution in little specially appointed systems.
- Less information about far off hubs.
- The ascend in organize estimate likewise builds the capacity intricacy and preparing overhead of steering table.
 - Insufficient data for course building up.

3.1.2 Reactive (On Demand)

On-Request/Receptive directing convention begins course revelation when correspondence with another hub is required to decrease arrange movement.

Advantages

- To refresh directing table not require intermittent flooding the system.

- Flooding requires when it is requested.
- Beaconless so it spares the data transmission..

Disadvantages

- For course discovering dormancy is high.
- Excessive flooding of the system causes disturbance of hubs correspondence.

3.1.2.1 AODV

Specially appointed On-Request Separation Vector directing convention [14] builds up a way while bundle exchange. It has the capacity of unicast and multicast directing. It utilizes a goal succession number which makes it not quite the same as other on-request directing conventions.

Advantages

- And mode way to the goal due to utilizing goal arrangement number.
- Extra memory prerequisites and course repetition are decreased.
- It reacts to the connection disappointment in the system and can be connected to the huge scale specially appointed system.

Disadvantages

- More time is required for association setup and starting correspondence to build up a course contrasted with different methodologies.
- The center hubs comprise old sections it can lead irregularity in the course.
- For a solitary course answer bundle if there have different course answer parcels this will prompt overwhelming control overhead.

3.2 GEOGRAPHIC (Location Based) ROUTING PROTOCOLS

Geographic steering is a directing that every hub knows its own and neighbor hub geographic position by the position deciding administrations like GPS. It doesn't keep up any steering table or trade any connection state data with neighbor hubs.

Advantages

- Route revelation and administration isn't required.
- Scalability.
- Suitable for high hub portability design.

Disadvantages

- It requires position deciding administrations.
- Due to the nonattendance of satellite flags, the GPS gadget doesn't work in a passage.

3.2.1 DTN

DTN (Delay Tolerant Network) utilizes convey and forward technique to defeat visit disengagement of hubs in the system. A hub can't contact with different hubs and stores

the parcel in convey forward approach and sending in view of couple of metric of hubs neighbours..

3.2.1.1 VADD

VDD (Vehicle-Assisted Data Delivery) [15] depends on the idea of conveying and forward approach by utilizing predictable vehicle portability. Among proposed VAAD conventions H-VAAD indicates better execution.

Advantages

- DSR, VADD and scourge directing executes high conveyance proportion when contrasted with GPSR,
- It is reasonable for multi-jump information conveyance.

Disadvantages

- Due to change of topology and movement thickness it causes the expansive postponement.

3.2.2 BEACON

It means transmitting short his message intermittently. It uncovered nearness and position of a hub. A passage will be expelled from a neighbor table of an accepting hub in the event that it neglects to get a guide after a specific timeframe from the relating hub.

3.2.2.1 GPSR

GPSR (Greedy Perimeter Stateless Routing) [16] chooses a hub which is nearest to the last goal by utilizing reference point. It uses covetous sending computation in the event that it neglects to utilize border sending to choose a hub by means of bundle exchange.

Advantages

- To forward the bundle a hub needs to recall just a single bounce neighbor area.
- Forwarding parcel choices are made progressively.

Disadvantage

- The parcel header of medium hub never refreshes, notwithstanding of goal hub is moving its data.

3.2.3 OVERLAY

Overlap is a system that each hub is associated by computer-generated or consistent connections which is based over a current system.

3.2.3.1 Greedy Perimeter Coordinator Routing

This is a location based steering convention that utilizations insatiable counts to forward bundle in view of pre-chosen way organized to manage difficulties of city situations.No worldwide or outside data like static guide does not require in GPCR[17].

Advantages

- Does not require any worldwide or outer data.
- It uses fundamental streets in view of GPSR to speak to the planar chart.
 - It has no as normal a planarization issue like unidirectional connections, planar sub-charts and so on.

Disadvantages

- Depends on intersection hubs.
- Junction identification approach has issues, where the first approach flops on bend street and second approach bombs on a scanty street.

3.3 Cluster Based Routing

Group-based steering is favoured in bunches. A get-together of centres perceives themselves to be a bit of cluster and a center is appointed as gathering head will impact the package to gathering. Awesome versatility can be suited sweeping frameworks yet organize deferrals and overhead are caused while encircling gatherings in significantly convenient VANET. Different Groups based steering conventions are COIN and LORA_CBF [18].

3.4 Broadcast Routing

Communicate directing is every now and used as a piece of VANET for sharing, development, atmosphere and emergency, road conditions among vehicles and passing on advertisements and statements. The different Communicate directing conventions are BROADCOMM, UMB, VTRADE, and DV-CAST.

3.5 Geo Cast Routing

Geo cast routing is basically a location based multicast routing. The purpose of this approach is to deliver packet from source node to all other nodes within a specified geographical region (Zone of Relevance ZOR). In Geo cast directing vehicles outside the ZOR are not cautioned to keep away from pointless hurried response.Various Geo cast routing protocols are IVG, DG-CASTOR and DRG.

Table 1. Assessment of Protocols in VANET [19]

Routing Protocols	Routing Type	Position Information? (How to Use)	Hierarchical Structure?	Network Simulator	Simulation Scenario
AODV	Unicast	No	No	—	—
DSR	Unicast	No	No	—	—
GPSR	Unicast	Packet Forwarding	No	—	—
PRAODV/PRAODV-M [5]	Unicast	Route-Selection (lifetime prediction)	No	NS2	Simple highway model (20km segment only)
AODV-bis [12]	Unicast	Route-Req-Forwarding	No	—	—
GSR [16]	Unicast	Packet Forwarding	No	NS2	Real city model (from map)
GPCR [19]	Unicast	Packet Forwarding	No	NS2	Real city model (from map)
A-STAR [8]	Unicast	Packet Forwarding (also use traffic info.)	No	NS2	Grid city model
COIN [23]	Unicast	Cluster Formation	Yes	Own	Real highway model
LORA_CBF [10]	Unicast	Packet Forwarding (also location prediction)	Yes	OPNET	Simple circle and square road
Flooding	Broadcast	No	No	—	—
UMB [26]	Broadcast	Packet Forwarding	No	Own	Simple intersection road
V-TRADE/HV-TRADE [27]	Broadcast	Classify Forwarding Group	No	Own	Simple intersection
BROADCOMM [25]	Broadcast	Formation of Cells	Yes	Own	Simple highway model (15 nodes only)
Msg Dis Protcl [14]	Geocast	Packet Forwarding	No	Own	Simple highway model (10 km long)
IVG [30]	Geocast	Packet Forwarding	No	Glomosim	Simple highway model (10 km long, 100/200 nodes)
Cached Geocast [31]	Geocast	Packet Forwarding	No	NS2	Quadratic network (size from 1 km to 4km, 100 nodes)
Abiding Geocast [32]	Geocast	Packet Forwarding	No	—	—

IV. CONCLUSION

VANET (Vehicular Ad-hoc Network) is another innovation which has occupied tremendous consideration in the current years. VANET is a sub-class of Mobile impromptu systems which gives a recognized way to deal with Intelligent Transport System (ITS). Its fresh innovation coordinating specially appointed system, remote LAN (WLAN) and cell innovation to accomplish savvy between vehicle interchanges and enhance street activity wellbeing and proficiency. VANETs are recognized from different sorts of impromptu systems by their mixture arrange designs, qualities, and application situations. In this paper, we examined qualities, favourable circumstances, utilizations of VANETs and study late steering conventions. At long last the paper closes by an unthinkable correlation of the different directing conventions for VANET.

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